Precise orbit determination for Jason-1 satellite using on-board GPS data with centimeter-level accuracy

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The Jason-1 satellite obits have been computed using the on-board GPS data and the SHORDE-III procedure. Various orbit validations, including comparison with the Precise Orbit Ephemeris produced by JPL, orbit overlaps, and SLR residuals, indicated that the RMS radial accuracy is in the range of 1-2 cm.

As the on-board GPS has become one of the key POD approaches for LEO satellites and will be widely placed on the future LEO mission to support their orbit accuracy requirements, Shanghai Astronomical Observatory has developed the SHOEDEE-III procedure which may support zero-difference dynamic orbit determination as well as single-difference dynamic orbit determination using on-board GPS data by fixing GPS ephemeris and clock bias. This would give support to scientific missions equipped with GPS receivers, and make its due contribution to the future oceanographic, climatic and remote sensing missions of our own country.

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In order to test the POD accuracy of SHORDE-III, Peng and Wu processed two cycles (Dec. 19, 2002 to Jan. 7, 2003) of the Jason-1 on-board GPS data, and assessed the orbits by comparing POE, orbit overlaps and independent SLR validations. These results show that: 1)

there is no obvious systematic bias between POE and orbit solutions computed using the SHORDE-III procedure, the 3-D orbit difference RMS is about 5.71 cm, and the radial orbit RMS accuracy is about 1.71 cm; 2) the 3-D RMS of orbit overlaps is about 4.89 cm, and the radial RMS accuracy is about 1.45 cm; 3) no significant bias has been found for the SLR residuals. The 20-day statistic bias of the SLR residual with the 15-degree elevation cutoff is 0.07±3.69 cm, and the statistic bias of the 60-degree elevation cutoff is 0.49±1.61 cm.

The main conclusion reported by the authors is that the models, strategy, and procedure described in this study are viable for use in real-world situations, and provide highly accurate GPS-based solutions.

Reference: Peng DongJu-WU Bin. Precise orbit determination for Jason-1 satellite using on-board GPS data with cm-level accuracy. *Chinese Science Bulletin*, 2009, 54(2): 196-202

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